NASA Facts

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Life and Microgravity Sciences and Applications

Using the Space Environment to Improve Life on Earth

Life Sciences Programs

NASA's life sciences research investigates the role of gravity in shaping living systems. The resulting knowledge is used to insure the health and safety of space crews and to improve the health and the quality of life of people on Earth.

Through ground-based and in-flight research, life sciences programs investigate the effects of micro-gravity on plants and animals. Ground-based investigations obtain baseline information, validate flight experiment procedures and test experiment hardware. Flight research involves flying experiments on missions using the Space Shuttle and Russian space vehicles, such as the Bion satellite and Mir Space Station. Scientific investigations are carried out in:

- space biology
- space radiation
- human behavior and performance
- spacesuit functions
- space environmental factors and technologies
- space physiology and countermeasures
- environmental health and disease prediction
- advanced life support
- human factors engineering

Microgravity Science Programs

NASA's microgravity research program reveals important physical, chemical and biological processes that are obscured by gravity on Earth. Frequently, the research allows scientists to provide superior measurements of fundamental physical and biological properties unattainable on Earth. This data can be used to validate or challenge scientific theories, or serve as the basis for developing new theories to explain unexpected discoveries. For many scientific disciplines, research in the space environment is a new realm of discovery, providing fundamental insights that can serve as the basis for new applications and technology.

- biotechnology
- combustion science
- gravitational physics
- fluid physics
- materials science

A natural extension of traditional Earth-based laboratory science, NASA's program sets the international standard of excellence in space-based microgravity research. The research is evolving from the relatively short experiments possible during Shuttle flights to long-duration flights on orbiting platforms such as the Russian Mir Space Station and the International Space Station.

Resulting Beneficial Commercial Products

NASA's life and microgravity research projects have generated a wide range of benefits and spinoff products:

- Bioreactor — NASA developed this device to keep human and other cells alive and healthy during space experiments. It is already helping cancer research on Earth by providing a better way to grow and study tumors.
- Excimer Laser Angioplasty — In treating blockage of coronary arteries, this system uses a “cool” laser that removes arterial deposits with extraordinary precision and without unnecessary damage to arterial walls. The device resulted from a NASA-sponsored program to measure gases in the Earth's atmosphere.

- Cataracts — Technology originally used in spaceflight is being adapted for early cataract detection and effective medical treatment. Compact light-scattering probes are now being used in clinical trials with animal subjects, with human subject studies scheduled to begin later this year.
- Combustion — an important technique for establishing fuel-lean flames, which is vital to significant reduction in nitrogen oxide pollutants. Combustion has different properties in space, and NASA research offers new insights into this age-old tool of humanity.
- Cool Suits — The liquid cooling garment worn by astronauts has been adapted to help people born without sweat glands to eliminate excessive body heat. Some people with multiple sclerosis have found that the cool suit relieves their symptoms. In both cases, the cool suit technology enables them to lead much more normal lives.
- Faster, Better Blood Analyzer — NASA sponsored development of this versatile, economical instrument for the rapid separation and identification of blood components in very small quantities to maintain the health and safety of crews during long stays in space. It is both a research instrument and a diagnostic tool, with many applications in medicine, forensic science, pathology, biochemistry, and other biological sciences. Capable of analyzing a range of fluid substances other than blood, it also is finding use in the food, agricultural, cosmetic, and pharmaceutical industries.
- Implantable Medication Systems — Surgically implanting this system in a diabetic's abdomen can enable insulin to be replenished continuously to a patient's body. The pumping mechanism was based on a design developed for the Mars Viking lander.
- Remotely Programmable Pacemaker — Doctors can reprogram and fine-tune a pacemaker without the risks involved in surgical procedures by using bi-directional telemetry. This two-way communications technology was originally developed by NASA to communicate between Earth-orbiting satellites and ground stations.

Future Research

During 1995, the life and microgravity sciences programs will fund approximately 490 principal investigators and fly more than 130 science experiments.

Budget

The fiscal year 1995 budget for life and microgravity sciences is $483 million, a decrease of more than $24 million from 1994. To enhance its science and technology development activities in an era of level or declining budgets, NASA has established several cooperative ventures with external organizations and researchers, including other space agencies.

A total of $504 million is requested in the FY 1996 budget for the Office of Life and Microgravity Sciences and Applications (OLMSA). This funding will contribute to the discovery of new scientific knowledge by studying the effect of the space environment on important biological, chemical and physical processes. The fiscal year 1996 funding will provide for the development of experiments to fly on orbiting spacecraft, such as the Space Shuttle, Mir Space Station and the International Space Station, and support more than 500 principal investigators over a diverse range of disciplines at universities and colleges nationwide.

Partnerships

- Industry — Research results from microgravity experiments are used to enhance the nation's scientific, medical and industrial base. NASA tissue culture research, for example, has given the medical community a powerful new tool to study how cells form tissue, both in space and on Earth.
- Government — Agreements with the National Institutes of Health have led to joint workshops on the value of growing protein crystals in space. Proteins are important, complex biochemicals that serve a variety of purposes in living organisms. Determining the molecular structure of proteins will lead to a greater understanding of how the organisms function. Knowledge of the structures also can help the pharmaceutical industry develop disease-fighting drugs. In addition, NASA is collaborating with the institutes on several projects involving cancer research, including a technology to improve digital mammography techniques.